

# **EVALUATION OF BROADBAND APPLICATIONS TO AIRCRAFT MAINTENANCE SAFETY: A CASE STUDY OF GOODRICH AVIATION TECHNICAL SERVICES**

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In an effort to better understand the use of broadband technologies in the aviation maintenance environment, the researcher investigated the use of broadband technologies, electronic manuals, Portable Display Units (PDAs), and electronic scheduling at Goodrich Aviation Technical Services. The question was: how do state-of-the-art of broadband applications affect maintenance operations? The researcher gathered information about the broadband technologies used at Goodrich and discussed the advantages and disadvantages of these technologies with Goodrich personnel. Increased efficiency was the main advantage gained from using broadband technologies, whereas the biggest disadvantage was cost.

## **INTRODUCTION**

The goal of this research is to help gain an understanding of the human factors issues pertaining to the integration broadband technology into the maintenance environments. In particular, to identify the advantages and disadvantages in using portable display units, electronic manuals, and electronic scheduling in the aviation maintenance work environment. To do this, the researcher gathered product information for various broadband applications and discussed advantages and disadvantages of these applications with Goodrich Aviation Technical Services personnel.

Headquartered in Everett, Washington, Goodrich Aviation Technical Services provides maintenance and repair to over 400 airlines. Currently, with over 2,600 employees, it is the North America's largest independent aircraft maintenance provider, servicing more than 500 aircraft per year. Goodrich offers a full-range of maintenance services, including: Aircraft modifications, passenger-to-freighter conversions, heavy airframe maintenance, component repair and overhaul, engineering and certification, and aircraft painting.

## **BROADBAND TECHNOLOGIES**

### **Electronic Manuals**

In the past, mechanics had to wade through mountains of paper or microfilm to get the

maintenance information they needed. Not only was this process tedious, it was difficult to keep the information updated.

Goodrich uses Boeing On-Line Delivery or (BOLD), which is a service that provides digital maintenance manuals, structural repair manuals, and manufacturer drawings from a central database. BOLD is a web-based application, and requires only a personal computer with a standard internet connection to use.

There are numerous advantages to using electronic manuals. Before the implementation of BOLD, countless hours were spent updating paper and/or microfilm documents. BOLD is updated on a daily basis. And since BOLD is issued through a central server, it is easy to ensure employees have access to the latest revision of each manual. The time formerly spent updating manuals can now be more wisely used on the hangar floor.

Computer kiosks with access to BOLD are readily available throughout the hangar floor. In addition, BOLD can be used for more than maintenance manuals; service bulletins, maintenance tips, in-fleet reports and other documents are available through the service. In the future, more features will be added, such as product standards and detailed technical drawings. Also, self-paced training programs may be accessed through BOLD.

In addition to BOLD, Goodrich also has manuals for private and foreign operators on a local server in standard Adobe pdf. format.

However, there are a few disadvantages of using BOLD. First, Employees need training in how to use the system. Though this can be a relatively quick and painless process for those comfortable with computers, it may take a little longer for those who are not computer savvy. Second, in some cases, the electronic documentation may not be as easy to read as paper documents (for example, certain highly detailed documents, such as system schematics). There is also the issue of personal preference. Some employees may just *prefer* working with paper documents and be unhappy about making the switch to computers. Lastly, is the issue of cost. To implement BOLD, an organization must subscribe to the service and also purchase enough computers to allow the material to be readily accessible to the employees.

### **Portable Display Units (PDAs)**

In an effort to reduce downtime during heavy maintenance checks, Goodrich implemented Perceptive Solution's Handheld NRC 2.0. Perceptive tailored the program to meet the requirements and specifications of Goodrich. These wireless hand-held devices offer a number of advantages over the traditional paper-and-pencil process.

In the past, the first part of a heavy maintenance check involved time-consuming paperwork and data entry. First, inspectors would conduct their inspections based on the customer's maintenance program. Non-routine maintenance items would be hand-written onto the specific customer's forms. Then, the customer's forms would be entered into a computer. From there, Goodrich and the customer would talk about the non-routine items and come to an agreement on which items should be completed. This procedure left plenty of opportunity for human factors errors, both from errors in filling out the forms and in data entry.

The new process, using PDAs, allows inspectors to generate work orders right on the hangar floor. The

major advantage of using the PDA rather than writing out work orders by hand is speed. Each PDA is programmed with commonly used non-routine maintenance items, which the inspector can pick and choose from.

The program maximizes efficiency and virtually eliminates errors of omission by leading the inspector through a series of programmed procedures, the non-routine maintenance item paperwork is actually being created *while* the aircraft is being inspected. As soon as the inspection is finished, the inspector merely pushes a button on his PDA, sending the document via radio-transmission directly to the computer system. Once in the computer, leads and supervisors can access it, allowing the work to begin immediately. Rather than having to wait for all of the paperwork to be written up and entered into the computer by a data entry person, the mechanics can go right to work.

For the first time at Goodrich, mechanics can actually be working on the non-routine items before the inspection is even completed. Because the lag time has been eliminated, it is estimated Goodrich has been able to shave 16 hours off a typical 40-hour inspection.

One drawback of using PDAs is that training is necessary. Goodrich let inspectors take the PDAs home to become familiar with them, and allow them to practice the specialized handwriting necessary to operate one. After two or three weeks, most inspectors seemed comfortable using the PDAs, and within a few months, all of the inspectors were proficient and seemed generally satisfied with their PDAs. Another issue is cost. The cost of implementing Perceptive Solutions' Handheld NRC was about \$500,000. However, with the increased efficiency gained from implementing the system, it can be argued this cost will be recouped in the future.

### **Electronic Scheduling Tool**

Goodrich uses Open Plan, an "off the shelf" electronic scheduling tool. Open Plan is similar in format to Microsoft Project. Since a typical D-check (complete structural overhaul) is complex and

usually involves 160 mechanics, 1,500 work orders, and thousands of manhours, Open Plan offers the tremendous benefit of tracking and organizing the entire process.

To customize the scheduling tool for Goodrich's purposes, they asked their maintenance experts to analyze a typical D-check, and break it down into individual activities needed for successful completion. Then, estimates for completion time were calculated for each activity.

Supervisors are able to track 800 to 1,300 activities in an aircraft maintenance schedule. Activities are listed in order of importance, with the most critical activities at the top of the list. Also, each activity has an estimation of the time it will take to be completed. Supervisors assign work cards, which list various maintenance duties, to mechanics. Leads must input a start and end time for each activity. This allows the schedule be analyzed and updated continuously. If the progress on an aircraft falls behind schedule, management is alerted with an electronic notification. This allows managers to shift resources to the stalled aircraft to help get it back on schedule.

Maintenance activities can also be organized by work type (e.g., painting) and all work of that particular type can be scheduled for a certain day.

The biggest advantage to using the electronic scheduling tool is increased efficiency. Before the implementation of Open Plan, a D-check took about 37 days. Now, it only takes about 27 days. This time saved means cost savings for Goodrich. Using Open Plan has streamlined the entire maintenance process so that time is no longer wasted due to lack of coordination.

Another benefit of using Open Plan, is that it gives customers a chance to check on the status of their aircraft. Using the internet and a password, customers can get a current report of their aircraft. Armed with the knowledge of precisely when the aircraft will be ready, they are better able to plan future flights for the aircraft.

Like any new program, Open Plan requires user training, although it is relatively easy to learn. Another issue to consider is the cost of the program, which was about \$500,000.

## **CONCLUSIONS**

The broadband technologies used by Goodrich offer many advantages over traditional methods. Electronic manuals, Portable Display Units (PDAs), and electronic scheduling have all led to increased efficiency. The greatest drawback is the cost of implementing these technologies.